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MOORES LAKE, KENT COUNTY, DELAWARE. EPA REGION III

Pacific Northwest Environmental Research Laboratory

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June 1975

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT ON

MOORES LAKE

KENT COUNTY

DELAWARE

EPA REGION III

WORKING PAPER No. 238

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

An Associate Laboratory of the

NATIONAL ENVIRONMENTAL RESEARCH CENTER - CORVALLIS, OREGON

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REPORT ON

MOORES LAKE

KENT COUNTY

DELAWARE

EPA REGION III

WORKING PAPER No. 238

WITH THE COOPERATION OF THE

DELAWARE DEPARTMENT OF NATURAL RESOURCES

AND ENVIRONMENT CONTROL AND THE

DELAWARE NATIONAL GUARD

JUNE 1975

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		05B 05C

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REPORT ON MOORES LAKE

KENT COUNTY, DELAWARE, EPA REGION III

by

National Eutrophication Survey

Water and Land Monitoring Branch
Monitoring Applications Laboratory
National Environmental Research Center
Las Vegas, Nevada

and

Eutrophication Survey Branch
Pacific Northwest Environmental Research Laboratory
National Environmental Research Center
Corvallis, Oregon

Working Paper No. 238

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

June 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin

planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Delaware Department of Natural Resources and Environmental Control for professional involvement and to the Delaware National Guard for conducting the tributary sampling phase of the Survey.

Mr. N. C. Vasuki, Director, Division of Water Pollution Control, Department of Natural Resources and Environmental Control, provided invaluable lake documentation and counsel during the course of the Survey.

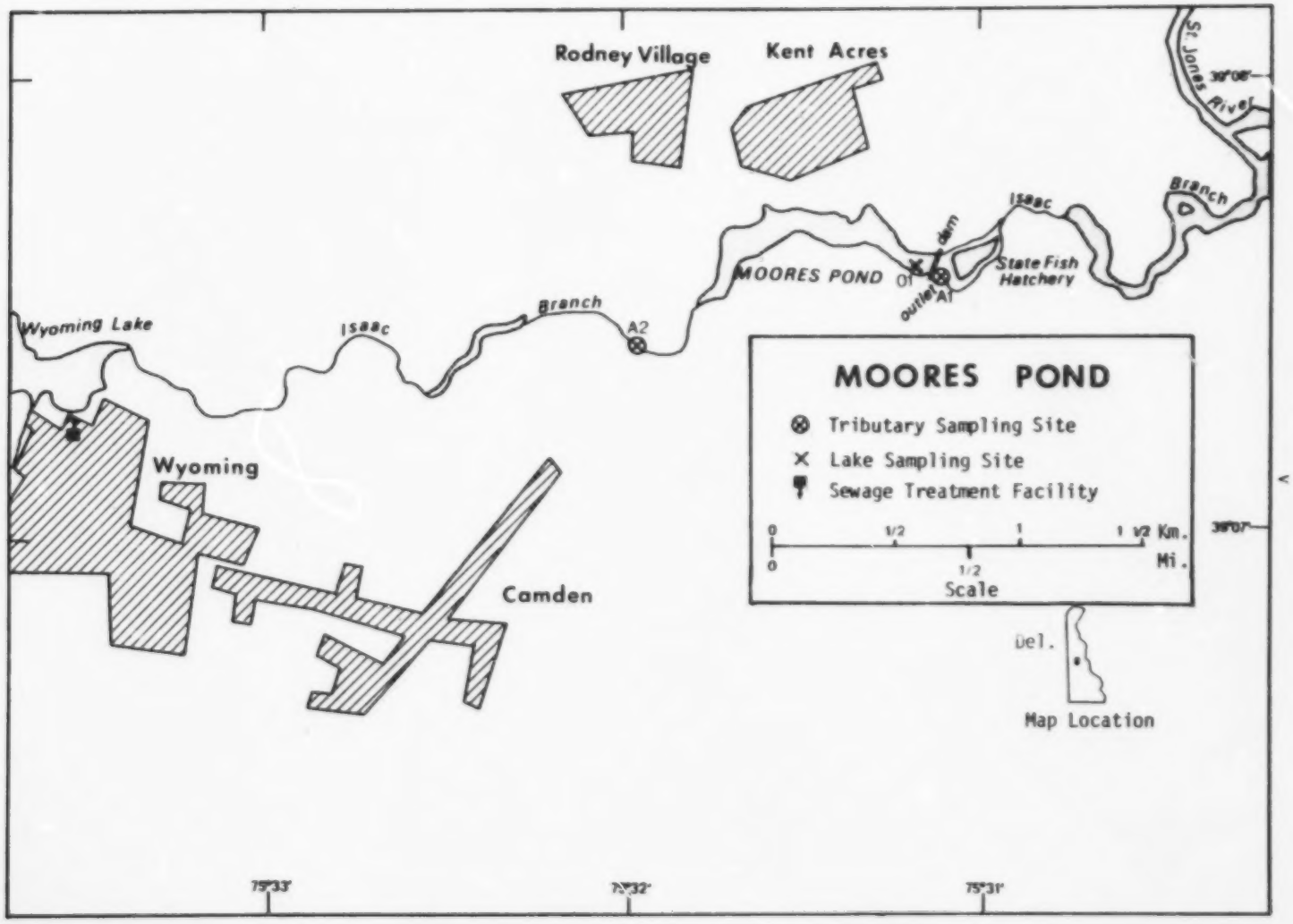
Major General Clarence E. Atkinson, the Adjutant General of Delaware, and Project Officer Colonel Donald S. Robinson, who directed the volunteer efforts of the Delaware National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF DELAWARE

LAKE NAME	COUNTY
Killen Pond	Kent
Moores Lake	Kent
Noxontown Pond	New Castle
Silver Lake	New Castle
Williams Pond	Sussex
Trussum Pond	Sussex


Rodney Village
Kent Acres
St. Jones River
Branch
Isaac
dam
State Fish Hatchery
MOORES POND
O1
outlet
A1
Branch
Isaac
A2
Wyoming Lake
Wyoming
Camden
MOORES POND
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0
1/2
1
1 1/2 Km.
0
1/2
Mi.
Scale
Del.
Map Location
75°33'
75°32'
75°31'

MOORES LAKE

STORET NO. 1005

I. CONCLUSIONS

A. Trophic Condition:

Moores Lake is considered eutrophic based upon field observations and analysis of Survey data. The lake is characterized by extremely high chlorophyll a levels and algal assay control yields. Nutrient levels were high (0.245 mg/l median total phosphorus and 2.400 mg/l median inorganic nitrogen) and Secchi disc visibility was low. Phytoplankton genera identified were generally high pollution-tolerant forms. Problem algal blooms and unstable water levels have been reported (Ketelle, 1971; Lesser, 1966); the lake has a record of intensive chemical weed control programs.

B. Rate-Limiting Nutrient:

Algal assay results indicate that Moores Lake was limited by available phosphorus levels at the time of assay sample collection. Spikes with phosphorus, and nitrogen and phosphorus simultaneously result in increases in assay yield. Additions of nitrogen alone did not stimulate a growth response. Lake data concerning the ratios of avilable nitrogen to orthophosphorus in sampled waters substantiate these results.

C. Nutrient Controllability:

1. Point Sources - During the sampling year, the mean annual phosphorus load from point sources (the Camden-Wyoming wastewater treatment plant) was estimated to be 40.9% of the total load reaching Moores Lake. Although total elimination of this point source input would reduce loading to Moores Lake, reduction of nonpoint source loading as well as point source would be needed to substantially upgrade water quality.

2. Nonpoint Sources - The mean annual phosphorus load from nonpoint sources was 59.1% of the total load reaching Moores Lake. The Isaac Branch contributed 54.9% of the total phosphorus load, and the ungaged drainage areas were estimated to have contributed 4.0%.

The present loading rate of 73.15 g $P/m^2/yr$ is approximately 23 times the "dangerous" (eutrophic) rate proposed by Vollenweider (in press) for a lake of such volume and detention time. However, Vollenweider's model may not apply to water bodies with short hydraulic retention times, and the mean hydraulic retention time for Moores Lake is only 2 days. Determination of surrounding land uses and unknown nonpoint sources contributing loading is necessary before recommendations for lake improvement can be proposed.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake surface area was provided by the State of Delaware; mean depth was estimated based on Survey data; tributary flow data were provided by the Delaware District Office of the U.S. Geological Survey (USGS)(outlet drainage area includes the lake surface area). Mean hydraulic retention time was obtained by dividing the lake volume by mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 0.10 km^2.
2. Mean depth: 1.1 meters.
3. Maximum depth: ? meters.
4. Volume: 0.110×10^6 m^3.
5. Mean hydraulic retention time: 2 days.

B. Tributary and Outlet (see Appendix C for flow data):

1. Tributaries -

Name	Drainage area(km^2)	Mean flow (m^3/sec)
A(2) Isaac Branch	33.7	0.75
Minor tributaries & immediate drainage -	1.4	0.03
Totals	35.1	0.78
2. Outlet - A(1) Isaac Branch	35.2	0.79

C. Precipitation:

1. Year of sampling: 113.9 centimeters.

2. Mean annual: 107.4 centimeters.

III. LAKE WATER QUALITY SUMMARY

Moores Lake was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from one station on the lake and one or more depths at that station (see map, page v). During each visit, depth-integrated samples were collected from the station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first visit, an 18.9-liter depth-integrated sample was composited for algal assays. The maximum depth sampled was 0.9 meters. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix D and are summarized in III A for waters at the surface and at the maximum depth for the sampling site. Results of the phytoplankton counts and chlorophyll a determinations are included in III B. Results of the limiting nutrient study are presented in III C.

A. PHYSICAL AND CHEMICAL CHARACTERISTICS

PARAMETER	(4/10/73) S*** = 1 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(7/20/73) S*** = 1 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(9/28/73) S*** = 1 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)
TEMPERATURE (DEG CENT)												
0.-1.5 M DEPTH	2	13.9- 13.9	13.9	0.0- 0.9	1	26.3- 26.3	26.3	0.0- 0.0	0	*****-*****	*****	*****-*****
MAX DEPTH**	1	13.9- 13.9	13.9	0.9- 0.9	1	26.3- 26.3	26.3	0.0- 0.0	0	*****-*****	*****	*****-*****
DISSOLVED OXYGEN (MG/L)												
0.-1.5 M DEPTH	1	10.3- 10.3	10.3	0.9- 0.9	1	15.2- 15.2	15.2	0.0- 0.0	0	*****-*****	*****	*****-*****
MAX DEPTH**	1	10.3- 10.3	10.3	0.9- 0.9	1	15.2- 15.2	15.2	0.0- 0.0	0	*****-*****	*****	*****-*****
CONDUCTIVITY (UMHOS)												
0.-1.5 M DEPTH	2	142.- 145.	144.	0.0- 0.9	1	139.- 139.	139.	0.0- 0.0	1	100.- 100.	100.	0.0- 0.0
MAX DEPTH**	1	142.- 142.	142.	0.9- 0.9	1	139.- 139.	139.	0.0- 0.0	1	100.- 100.	100.	0.0- 0.0
PH (STANDARD UNITS)												
0.-1.5 M DEPTH	2	8.5- 8.5	8.5	0.0- 0.9	1	9.2- 9.2	9.2	0.0- 0.0	0	*****-*****	*****	*****-*****
MAX DEPTH**	1	8.5- 8.5	8.5	0.9- 0.9	1	9.2- 9.2	9.2	0.0- 0.0	0	*****-*****	*****	*****-*****
TOTAL ALKALINITY (MG/L)												
0.-1.5 M DEPTH	2	10.- 19.	15.	0.0- 0.9	1	21.- 21.	21.	0.0- 0.0	1	36.- 36.	36.	0.0- 0.0
MAX DEPTH**	1	10.- 10.	10.	0.9- 0.9	1	21.- 21.	21.	0.0- 0.0	1	36.- 36.	36.	0.0- 0.0
TOTAL P (MG/L)												
0.-1.5 M DEPTH	2	0.195-0.221	0.208	0.0- 0.9	1	0.286-0.286	0.286	0.0- 0.0	1	0.270-0.270	0.270	0.0- 0.0
MAX DEPTH**	1	0.221-0.221	0.221	0.9- 0.9	1	0.286-0.286	0.286	0.0- 0.0	1	0.270-0.270	0.270	0.0- 0.0
DISSOLVED ORTHO P (MG/L)												
0.-1.5 M DEPTH	2	0.071-0.072	0.071	0.0- 0.9	1	0.051-0.051	0.051	0.0- 0.0	1	0.143-0.143	0.143	0.0- 0.0
MAX DEPTH**	1	0.072-0.072	0.072	0.9- 0.9	1	0.051-0.051	0.051	0.0- 0.0	1	0.143-0.143	0.143	0.0- 0.0
NO2+NO3 (MG/L)												
0.-1.5 M DEPTH	2	2.700-2.800	2.750	0.0- 0.9	1	1.300-1.300	1.300	0.0- 0.0	1	1.960-1.960	1.960	0.0- 0.0
MAX DEPTH**	1	2.700-2.700	2.700	0.9- 0.9	1	1.300-1.300	1.300	0.0- 0.0	1	1.960-1.960	1.960	0.0- 0.0
AMMONIA (MG/L)												
0.-1.5 M DEPTH	2	0.090-0.100	0.095	0.0- 0.9	1	0.060-0.060	0.060	0.0- 0.0	1	0.050-0.050	0.050	0.0- 0.0
MAX DEPTH**	1	0.090-0.090	0.090	0.9- 0.9	1	0.060-0.060	0.060	0.0- 0.0	1	0.050-0.050	0.050	0.0- 0.0
KJELDAHL N (MG/L)												
0.-1.5 M DEPTH	2	0.700-0.800	0.750	0.0- 0.9	1	1.800-1.800	1.800	0.0- 0.0	1	1.700-1.700	1.700	0.0- 0.0
MAX DEPTH**	1	0.800-0.800	0.800	0.9- 0.9	1	1.800-1.800	1.800	0.0- 0.0	1	1.700-1.700	1.700	0.0- 0.0
SECCHI DISC (METERS)	1	0.6- 0.6	0.6		1	0.6- 0.6	0.6		1	0.9- 0.9	0.9	

* N = NO. OF SAMPLES
** MAXIMUM DEPTH SAMPLED AT EACH SITE
*** S = NO. OF SITES SAMPLED ON THIS DATE

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera		Algal Units per ml
04/10/73	1.	Cyclotella	4,545
	2.	Melosira	1,673
	3.	Synedra	545
	4.	Navicula	400
	5.	Asterionella	218
		Other genera	837
		Total	8,218
07/20/73	1.	Melosira	48,050
	2.	Flagellates	6,231
	3.	Cryptomonas	3,755
	4.	Scenedesmus	2,901
	5.	Actinastrum	2,646
		Other genera	3,155
		Total	66,738
09/28/73	1.	Melosira	54,865
	2.	Centric Diatoms	21,946
	3.	Scenedesmus	7,659
	4.	Cyclotella	5,258
	5.	Crucigenia	3,315
		Other genera	11,344
		Total	104,387

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (micrograms/liter)
04/10/73	1	16.9
07/20/73	1	92.5
09/28/73	1	134.4

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked:

Spike(mg/l)	Ortho P Conc.(mg/l)	Inorganic N Conc.(mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.10	2.996	43.1
0.05 P	0.15	2.996	56.3
0.05 P + 1.0 N	0.15	3.996	66.3
1.00 N	0.10	3.996	42.9

2. Discussion -

The control yield of the assay alga, *Selenastrum capricornutum*, indicates that the potential for primary production in Moores Lake was very high at the time of sampling. The increase in yield with the addition of phosphorus as well as the lack of increase when only nitrogen was added indicates phosphorus limitation. Maximum growth potential was achieved with the simultaneous addition of both phosphorus and nitrogen.

The ratios of the inorganic nitrogen to orthophosphorus for the spring, summer, and fall samples were respectively 40:1, 27:1, and 14:1, further indicating phosphorus limitation.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Delaware National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of February and March when two samples were collected. Sampling was begun in April 1973 and was completed in March 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Delaware District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of the USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual concentrations in Isaac Branch at Station A(2) and mean annual ZZ flow.

The operator of the Camden-Wyoming wastewater treatment plant provided monthly effluent samples and corresponding flow data.

A. Waste Sources:

1. Known municipal -

Name	Population Served	Treatment	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Camden-Wyoming	2,800	Extended Aeration	0.942	Isaac Branch

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load) -		
A(2) Isaac Branch	4,015	54.9
b. Minor tributaries & immediate drainage (nonpoint load) -	290	4.0
c. Known municipal STP's -		
Camden-Wyoming	2,995	40.9
d. Septic tanks* -	10	0.1
e. Known industrial - None		
f. Direct precipitation** -	5	0.1
Totals	7,315	100.0

2. Output - Isaac Branch 5,825

3. Net annual P accumulation 1,490

*Estimate based on 36 lakeside residences.
**Estimated (see NES Working Paper No. 175).

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
A(2) Isaac Branch	91,610	92.0
b. Minor tributaries & immediate drainage (nonpoint load) -	3,625	3.6
c. Known municipal STP's -		
Camden-Wyoming	3,855	3.9
d. Septic tanks * -	385	0.4
e. Known industrial - None		
f. Direct precipitation** -	105	0.1
Total	99,580	100.0

2. Outputs - Isaac Branch 99,275

3. Net annual N accumulation - 305

*Estimate based on 36 lakeside residences.
**Estimated (see NES Working Paper No. 175).

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
A(2) Isaac Branch	119	2,718

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible."

	Total Yearly Phosphorus Loading Rate (grams/m^2/year)
Estimated loading rate for Moores Lake	73.15
Vollenweider's "dangerous" or eutrophic rate	3.15
Vollenweider's "permissible" or oligotrophic rate	1.57

V. LITERATURE REVIEWED

Ketelle, Martha J. and Paul D. Uttormark. 1971. "Problem Lakes in the United States." U.S. Environmental Protection Agency Project #16010 EHR. University of Wisconsin, Madison, Wisconsin.

Lesser, Charles A. 1966. "Aquatic Vegetation Survey; Federal Aid in Fish Restoration." Project #F-21-R. Delaware Fish and Game Commission, Dover, Delaware.

U.S. Environmental Protection Agency. 1975. "National Eutrophication Survey Methods 1973-1976." Working Paper No. 175. NERC, Las Vegas, Nevada and PNERL, Corvallis, Oregon.

Vollenweider, Richard A. (in press). "Input-Output Models." Schweiz. Z. Hydrol.

CONVERSION FACTORS

Hectares x 2.471 = acres

Meters x 3.281 = feet

Cubic meters x 8.107 x 10^{-4} = acre feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX B

PARAMETRIC RANKINGS OF LAKES

SAMPLED BY NES IN 1973

STATE OF DELAWARE

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P
1002	KILLEN POND	0.170	1.610	479.333	116.200	12.000	0.042
1005	MOORES LAKE	0.245	2.400	472.667	81.267	4.700	0.071
1007	NOXONTOWN POND	0.160	0.530	478.833	37.600	10.400	0.016
1008	SILVER LAKE	0.227	4.750	465.667	26.700	13.000	0.096
1009	WILLIAMS POND	0.042	2.010	449.333	30.100	8.800	0.010
1010	TRUSSUM POND	0.038	1.280	464.000	5.100	5.800	0.011

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1002	KILLEN POND	40 (2)	60 (3)	0 (0)	0 (0)	20 (1)	40 (2)
1005	MOORES LAKE	0 (0)	20 (1)	40 (2)	20 (1)	100 (5)	20 (1)
1007	NOXONTOWN POND	60 (3)	100 (5)	20 (1)	40 (2)	40 (2)	60 (3)
1008	SILVER LAKE	20 (1)	0 (0)	60 (3)	80 (4)	0 (0)	0 (0)
1009	WILLIAMS POND	80 (4)	40 (2)	100 (5)	60 (3)	60 (3)	100 (5)
1010	TRUSSUM POND	100 (5)	80 (4)	80 (4)	100 (5)	80 (4)	80 (4)

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR DELAWARE 10/20/75

LAKE CODE 1005 MOORES LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ MI) 13.60

NORMALIZED FLOWS(CFS)

TRIBUTARY	SUB-DRAINAGE AREA(SQ MI)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1005A1	13.60	34.00	46.80	48.90	39.30	25.00	19.10	17.00	32.40	12.80	14.00	17.50	28.70	27.87
1005A2	13.00	32.50	44.70	46.70	37.60	23.90	18.30	16.20	31.00	12.20	13.40	16.80	27.40	26.64
1005ZZ	0.60	1.50	2.10	2.20	1.70	1.10	0.80	0.80	1.40	0.60	0.60	0.70	1.30	1.23

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 13.60
SUM OF SUB-DRAINAGE AREAS = 13.60

TOTAL FLOW IN = 335.50
TOTAL FLOW OUT = 335.50

MEAN MONTHLY FLOWS AND DAILY FLOWS(CFS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1005A1	4	73	50.00	28	50.00				
	5	73	24.20	20	22.00				
	6	73	16.50	26	12.00				
	7	73	11.70	22	12.00				
	8	73	16.70	18	6.80				
	9	73	8.90	9	5.40				
	10	73	9.80	31	9.60				
	11	73	10.00	14	9.40				
	12	73	32.00	2	6.00				
	1	74	42.40	16	43.00				
	2	74	35.00	9	37.00	24	30.00		
	3	74	39.20	10	20.00	24	43.00		
1005A2	4	73	48.00	28	48.00				
	5	73	23.20	20	22.00				
	6	73	15.70	26	12.00				
	7	73	11.20	22	11.00				
	8	73	15.90	18	6.70				
	9	73	8.60	9	5.20				
	10	73	9.40	31	9.30				
	11	73	9.60	14	9.10				
	12	73	31.00	2	5.80				
	1	74	40.80	16	41.00				
	2	74	33.70	9	36.00	24	29.00		
	3	74	37.70	10	19.00	24	41.00		
1005ZZ	4	73	2.20	28	2.20				
	5	73	1.10	20	1.00				
	6	73	0.70	26	0.50				
	7	73	0.50	22	0.50				
	8	73	0.70	18	0.30				
	9	73	0.40	9	0.20				
	10	73	0.40	31	0.40				
	11	73	0.40	14	0.40				
	12	73	1.40	2	0.30				
	1	74	1.90	16	1.90				
	2	74	1.60	9	1.60	24	1.30		
	3	74	1.70	10	0.90	24	1.70		

19.

APPENDIX D

PHYSICAL AND CHEMICAL DATA

STORET RETRIEVAL DATE 75/10/16

100501
39 07 34.0 075 31 10.0
MOORES LAKE
10 DELAWARE

11EPALES
3

2111202
0003 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/10	12 10	0000	13.9		22	145	8.50	19	0.100	0.700	2.800	0.071
	12 10	0003	13.9	10.3		142	8.50	18K	0.090	0.800	2.700	0.072
73/07/20	12 45	0000	26.3	15.2	24	139	9.20	21	0.060	1.800	1.300	0.051
73/09/28	15 50	0000			36	100J		36	0.050	1.700	1.960	0.143

21.

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/10	12 10	0000	0.195	16.9
	12 10	0003	0.221	
73/07/20	12 45	0000	0.286	92.5
73/09/28	15 50	0000	0.270	134.4

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX E

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/10/16

1005A1
39 07 30.0 075 31 00.0
ISAAC BRANCH
10 7.5 DOVER
O/MOORES POND
FOOTBRIDGE AT MAIN SPILLWAY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/04/28	11 30		2.500	1.230	0.132	0.090	0.180
73/05/20	16 30		2.600	0.960	0.068	0.120	0.245
73/06/25	20 40		1.400	1.260	0.035	0.088	0.240
73/07/23	11 30		1.400	1.600	0.060	0.080	0.300
73/08/20	12 10			1.800	0.020	0.091	0.300
73/09/09	15 20		1.200	1.320	0.035	0.110	0.300
73/10/31	10 15		2.000	1.550	0.168	0.210	0.360
73/11/14	10 15		2.500	1.600	0.061	0.147	0.260
73/12/02	14 45		2.760	0.700	0.136	0.208	0.280
74/01/16	15 10		3.780	0.400	0.368	0.105	0.140
74/02/09	15 30		4.300	1.300	0.100	0.125	0.165
74/02/24	16 30		4.000	1.300	0.120	0.040	0.230
74/03/10	16 00		3.200	0.600	0.015	0.110	0.200
74/03/24	16 30		2.940	1.300	0.075	0.075	0.195

23.

STORET RETRIEVAL DATE 75/10/16

1005A2
39 07 30.0 005 32 00.0
ISAAC BRANCH
10 7.5 WYOMING
I/MOORES POND
US HWY 113 BRDG 2.3 MI S OF DOVER
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/04/28	11 45		2.700	0.740	0.043	0.078	0.160
73/05/20	16 00		3.100	1.050	0.077	0.252	0.345
73/06/25	16 30		2.200	1.100	0.100	0.315	0.440
73/07/23	11 20		2.200	1.050	0.120	0.150	0.290
73/08/20	12 00			0.960	0.058	0.198	0.360
73/09/09	15 30		2.400	0.820	0.067	0.378	0.490
73/10/31	10 28		2.600	0.812	0.027	0.084	0.155
73/11/14	10 00		2.520	0.700	0.035	0.138	0.240
73/12/02	15 15		3.200	0.750	0.068	0.370	0.445
74/01/16	15 10		4.100	0.400	0.290	0.120	0.160
74/02/09	15 30		4.600	3.200	0.270	0.170	0.300
74/02/24	16 00		4.300	1.000	0.185	0.220	0.315
74/03/10	16 30		3.600	0.800	0.085	0.210	0.290
74/03/24	17 00		2.640	1.200	0.040	0.130	0.280

24.

STORET RETRIEVAL DATE 75/10/16

1005AA EA1005AA P003800
39 07 16.0 075 33 31.0
CAMDEN-WYOMING
10 7.5 WYOMING
T/MOORES POND
ISAAC BRANCH
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/01/08 11 00 P CP(T)- 74/01/08 16 00			17.000	0.820	0.040K	7.560	7.560	0.282	0.220
74/02/13 08 00 P CP(T)- 74/02/13 16 00			16.000	3.000	0.160	7.800	8.500	0.296	0.260
74/03/12 08 00 P CP(T)- 74/03/12 16 00			7.600	1.950	0.066	8.700	9.000	0.310	0.245
74/04/10 08 00 P CP(T)- 74/04/10 16 00			7.300	3.000	0.140	7.300	8.200	0.260	0.255
74/05/13 08 00 P CP(T)- 74/05/13 16 00			1.880	13.000	0.010	7.600	8.300	0.286	0.270
74/06/17 08 00 P CP(T)- 74/06/17 16 00			0.850	2.000	0.050	6.800	7.200	0.290	0.265
74/07/09 08 00 P CP(T)- 74/07/09 16 00			0.320	1.000	0.050	8.800	8.800	0.218	0.230
74/08/08 08 00 P CP(T)- 74/08/08 16 00				1.000K			6.300	0.218	0.220
74/09/09 08 00 P CP(T)- 74/09/09 16 00			9.500	1.700	0.082	8.925	9.400	0.354	0.285
74/10/17 08 00 P CP(T)- 74/10/17 16 00			9.400	1.600	0.063	9.600	9.600	0.320	0.255
74/11/11 08 00 P CP(T)- 74/11/11 16 00			5.600	1.800	0.135	9.700	9.700	0.245	0.235
74/12/05 08 00 P CP(T)- 74/12/05 16 00			7.040	4.400	0.050K	8.300	8.300	0.230	0.245

K VALUE KNOWN TO BE
LESS THAN INDICATED

25.

STORET RETRIEVAL DATE 75/10/16

1005AA EA1005AA P003800
39 07 16.0 075 33 31.0
CAMDEN-WYOMING
10 7.5 WYOMING
T/MOORES POND
ISAAC BRANCH
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/01/08	08 00	P							
CP(T)- 75/01/08	16 00		6.240	5.600	0.110	8.330	8.000	0.210	0.230

26.